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ABSTRACT

Using 48 educable mentally handicapped students (ages 12-18) as subjects, a study investigated the effect of prompted and trial-and-error procedures on the learning of a paired-associate task, when items (concrete nouns of less than six letters) in one list were drawn from the same categories (animals, food) and in a second list, from different categories. Results showed that prompting caused superior performance in the first situation, demonstrating that guided learning mitigates the interference caused by associating categories rather than stimulus response items. Other variables examined included interspersed non-reinforced test trials in the trial-and-error situation, and the order of presentation of the two lists. Related to the design of instructional materials, results suggest that, in the preparation of programed workbooks or similar items for the mantally handicapped, prompting would be an effective means of introducing new concepts for association with already familiar items. (KW)

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Training Procedure Interaction with Item Similarity

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June 1970

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Abstract

This study investigated the effect of prompted and trial-and-error procedures on learning a PA task when items in one list were drawn from the same categories and in a second list, from different categories. Prompting produced superior performance under the first condition, supporting the prediction that guided learning mitigates the interference caused by associating categories rather than stimulus response items. Other variables examined were interspersed, non-reinforced test trials in the trial-and-error condition and order of presentation of the two lists. Subjects were 48 students in Texas State Schools for the retarded.

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An instructional sequence which follows a paired-associate (PA) paradigm may require the learner to attempt a response on each trial, even though he will make some percentage of errors while learning, or it may require him only to receive complete information and respond immediately afterward, thus assuring that he will make no errors. In PA terms, the former is called the anticipation procedure; in more applied contexts it is called the trial-and-error or confirmation procedure. The latter is known as the study or prompting procedure; when blocks of test trials without feedback are interspersed between blocks of study trials in order to measure the rate of learning, the usual name given the procedure is study-test. Which of these methods produces greater learning may depend on the nature of the material to be learned. Specifically, the confirmation method may lead to more rapid learning when previously learned items and strategies transfer readily to the new learning situation. Where previous learning might be expected to interfere with new learning, however, the prompting procedure may be more effective because the subject (S) may be induced to merely learn the prompted response without attempting to transfer old strategies or knowledge to the new situation.

Underwood and Schulz (1961) found that one of the most difficult types of PA lists is that in which the members of one category are paired with the members of a second category. In their Experiment III, a list with category member-category member pairing was learned more slowly and with more overt errors than were lists in which category members were paired with single words from each of many categories and a list in which no two words came from the same category.

Underwood (1966) explained the above result in terms of transfer from pre-experimental learning of categories. When the S first

approaches a category-category list, well-learned category names are introduced by the S as mediators. However, these mediators retard rather than advance learning, because a single category name mediates more than one stimulus-response pair. Thus, the S quickly learns that, for example, animals are paired with countries; but the mediator "country" occurs following presentation of each animal name and retards learning of the particular animal-particular country pairs. Underwood stated that the S cannot avoid the retardation of his learning produced by interference from the category name mediators, since "the subject has little if any control over the well-learned categorizing response" (p. 51). The hypothesis advanced here is that prompting may induce the S to attend only to the prompted response and to not transfer previously learned responses or strategies. The prediction follows that prompting should reduce the negative transfer from previously learned categories present in a PA task which pairs stimuli drawn from a single category with responses drawn from a second single category, thus making performance on that task more like performance on a task involving dissimilar items. In trial-and-error learning, on the other hand, Ss should attempt to use mediators, and thus a PA task involving category-category pairs should be more difficult than one in which the items are drawn from many different categories.

One procedural difference between the anticipation and study-test procedures is the insertion of separate test trials in the study-test procedure, while study and test occur together in the anticipation procedure. If there is a difference in rate of learning by the two methods, that difference may be due to learning which occurs on the separate test trials. Izawa (1968), with college students and recall tests, and Seitz and Sweeney (1969), with mental retardates and recognition tests, have found that interspersed non-reinforced test trials increase trial-and-error PA learning. However, Seitz and Sweeney found a significant effect only when two test trials were placed after every study trial. The present study included a comparison of confirmation PA learning with and without interspersed test trials, in an attempt to show a more clear-cut effect with mentally retarded Ss. It was predicted that learning would be greater under the anticipation procedure when non-feedback test trials were alternated with the practice trials than when there were no separate test trials, regardless of the composition of the list being learned. No prediction was made of the relative overall effectiveness of prompted and trial-and-error learning.

Method

Subjects. The Ss were 48 students enrolled in the educable programs of the Austin State School and the Denton State School, Texas Department of Mental Health and Mental Retardation. They were chosen on the basis of ability to read the stimulus materials. Ages ranged from 12 to 18. IQ's, as taken from school records are shown in Table I.

Insert Table 1 about here

A one-way analysis of variance revealed that there were no significant differences between the IQ scores for these groups ($F<1$).

Although Ss are randomly assigned by IQ rather than age, the age variable was apparently not a significant factor. Correlation coefficients were computed for correct responses and ages in each of the three major treatment groups. None of the three correlations were significant (for Prompting, $r=0.06$; for Confirmation I, $r=0.48$; for Confirmation II, $r=-0.02$).

Materials. Materials were concrete nouns of five letters or less taken from elementary reading materials with which the Ss were familiar. The two sets of materials differed in that one (Similar) consisted of eight stimuli drawn from the category of animals and eight responses drawn from the category of food; the other set (Dissimilar) contained eight unrelated stimuli and eight unrelated responses. Within each set, the stimulus and response words were paired randomly, and three other words from the response pool were presented with the correct response. The four response choices (one correct and three incorrect) were always the same for each stimulus, so that the eight words in the response pool appeared an equal number of times. The list was presented on the MTA-SR 400 Scholar, a device for automated presentation of printed material. Within each frame, a stimulus was centered at the top and the four response alternatives appeared horizontally, in random order, at the bottom. Pressing a key under the correct response resulted in the advance of the program.

Procedure. Subjects were assigned to three conditions in a manner to ensure that the mean IQ scores for the three groups were equivalent. In the Prompting condition, training was by the study-test procedure, and the correct response was underlined on study trials. No feedback was given on test trials; the program advanced after the S's first response. In Confirmation I, training was by anticipation and the correct response was never underlined; the S was allowed multiple responses and the program advanced after correct responses only. Test trials were as in the Prompting condition. In Confirmation II, training was again by the anticipation procedure, but the interspersed blocks of test trials were eliminated. The first response given on each practice trial was recorded as a test response. In all conditions, two unscored practice trials preceded training, which continued until twelve test trials had been given. All Ss were given both the Similar and Dissimilar list; each list was presented in a single session, with a week separating the two sessions. Two orders of presentation were used to parcel out variance attributable to practice. In Order 1 Ss were given the

similar list first; in Order 2 the dissimilar material was presented first. This procedure resulted in two variables between Ss, Treatment (Prompting, Confirmation I, and Confirmation II) and Order, and one within-S variable, List (Similar and Dissimilar.)

Results and Discussion

The mean numbers of correct responses over the 12 tests for each condition are given in Table 2. (Total possible correct in

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Insert Table 2 about here

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each condition was 96.) An analysis of variance indicated that both Treatment and List were significant variables ($F=72.182$, $df=2,42$, $p<.001$; and $F=18.3007$, $df=1,42$, $p<.001$, respectively). The Treatment main effect was due entirely to the depressed performance in Confirmation II, compared to the other two treatment conditions. The greater performance on the Dissimilar list is in agreement with Underwood and Schultz's finding that PA lists with one category on the stimulus side and one category on the response side are more difficult than lists drawn from many categories. The effect of Order did not reach significance ($F=2.5908$, $df=1,42$, $.10<p<.20$).

The Treatment by List, Treatment by Order, Order by List, and Treatment by Order by List interactions were all significant ($F=3.5086$, $df=2,42$, $p<.05$; $F=3.6378$, $df=2,42$, $p<.05$; $F=10.2941$, $df=1,42$, $p<.01$; and $F=3.4461$, $df=2,42$, $p<.05$, respectively). The Treatment by List interaction is due to the near equal performance on the two lists under Prompting, while performance was better on the Dissimilar than on the Similar list in both Confirmation I and II. Thus, the prediction that Prompting would reduce the negative transfer from prior learning in the Similar list is sustained. In addition, Prompting appears to reduce mediation, regardless of what kind of material is involved; the Dissimilar list, which should profit from mediation, was learned more poorly under Prompting than under Confirmation I.

The Order by List interaction results from the Dissimilar list being learned better than the Similar List in Order 1, while performance on the two lists was approximately equal in Order 2. Note that in Order 1, the Similar list preceded the Dissimilar list by a week; the two were reversed in Order 2. Thus, the interaction of Order and List appears to be the result of two factors. One is the greater ease of learning the Dissimilar list, as shown by the List main effect. The other is a practice effect; all else being equal, the second list should be easier to learn than the first

because of familiarity with the experimental procedure. These two factors work together in Order 1, where the second list learned is also the easier list; in Order 2, where the Similar list is learned second, they work in opposite directions and cancel each other out.

However, under the Prompting procedure, the two lists are approximately equal in Order 1 as well as in Order 2. The failure of Order and List to interact under Prompting as they did under the two confirmation procedures is reflected in the three-way interaction of Treatment, Order, and List. Since the Order by List interaction depends in part on the List difference, and since the Treatment by List interaction indicates that there was no List difference under Prompting, the three-way interaction is to be expected.

Somewhat more difficult to explain is the Treatment by Order interaction, which is due to superior performance in Order 1 than in Order 2 under Confirmation II, but no difference between the two orders under the other two treatments. Close examination revealed the interaction to be an artifact of a failure to randomly assign Ss to groups. All of the S in the Prompting and Confirmation I groups were residents at the Austin State School; the Confirmation II group was composed of four residents at the Austin State School and 12 residents at the Denton State School. The four Austin State School Ss were run in Order 1. Thus, although the groups were equated on IQ, they differed in school attended. A major difference between the two schools is the amount of verbal learning research done. It is highly likely that the Denton Ss had never before served in a verbal learning study; almost all the Austin Ss had participated in at least one previous experiment, and most had been in two or more. One would expect the more practiced Austin Ss to perform at a higher level than the experimentally naive Denton Ss. Partition of the Confirmation II Order 1 Ss on the basis of school attended reveals just such a difference. (See Table 3.) The Denton Ss in Order 1 gave a mean of 37.75 correct responses, a figure much more in line with the performance of Denton Ss in Order 2; the more experienced Austin Ss in Order 1 gave a mean of 61.75 correct responses. Thus, the Treatment by List interaction was due to non-random subject assignment and would not have occurred had the Denton Ss been divided among all groups.

The non-equivalent assignment of experienced and naive Ss to the various groups might have been responsible, in and of itself, for the other effects detailed above. Such a conclusion would be easy, since the naive Ss, who should be expected to perform more poorly, composed the groups which did, in fact, perform poorly. However, it can be shown that all the significant differences other than the Treatment by Order interaction would most likely have occurred even under random assignment of Ss. The difference between the Prompting and Confirmation I procedures, in each of which a mean of approximately 82 correct responses were given, and

Confirmation II is still a large one when only the Austin Ss in Confirmation II are considered. The latter Ss gave a mean of 61.75 correct responses, a full 25% fewer than those given by the other Austin Ss.

Since List was a within-Ss variable, the List main effect and the interactions involving List should be affected by subject selection less than other effects. Moreover, the superiority of the Dissimilar over the Similar list holds for the Austin Ss alone and for the Denton Ss alone within Confirmation II, as shown in Table 3. Since the difference between the lists remains after

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Insert Table 3 about here

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partitioning Ss on the basis of school, the Treatment by List interaction must also remain, the interaction merely reflecting a difference in List effects between the Prompting procedure and the two confirmation procedures. The Order by List interaction results from a difference in List effects for the two orders. While no Austin Ss were run in Confirmation II Order 2, both the Austin Ss and the Denton Ss in Confirmation II Order 1 showed the List effect showed by the Confirmation I Order 1 group, and the Denton Ss in Confirmation II Order 2 performed as did the Confirmation I Order 2 group. It is likely, therefore, that the Order by List interaction is not artifactual. Finally, the Treatment by Order by List interaction, since it is due to a failure for the Order by List interaction to occur under the Prompting treatment, would most likely have occurred had all the Ss been experienced.

While the non-random assignment of Ss from the two schools resulted in a confounding of the results, several conclusions may be tentatively drawn. The greater difficulty of learning a list with stimuli drawn from one category and responses drawn from a second category, as opposed to a list composed of items from many categories, was evidenced under all three procedures and agrees with the Underwood and Schultz finding. Similarly, the increase in learning effected by the inclusion of non-reinforced test trials agrees with past results.

Of greatest interest is the superiority of performance on the Dissimilar list under confirmation training, while the Dissimilar and Similar lists were learned equally well under the study procedure. This result is apparent even if one looks at only the Austin Ss (i.e., the Prompting and Confirmation I groups). Such an interaction of training procedure and similarity of items is likely due to a reduction of mediation from pre-experimental learning when training is by the prompting procedure. This effect could be predicted from

studies which have shown that retarded children rely on the prompt rather than attend the stimulus in prompted learning situations. (Seitz and Farmer, 1970; Achenbach and Zigler, 1968). In this case the prompt may have served the function of directing the Ss' attention to a single response word, rather than allowing him to attend all four highly similar response possibilities. The S could then move his attention from the prompting line to the correct response and thence directly to the association between the stimulus and correct response, without interference from the other response alternatives.

Results suggest that when preparing materials such as programmed workbooks for this subject population, prompting might be an effective means of introducting new concepts for association with already familiar items.

An experiment is now in progress which is designed to test the effects of prompting and confirmation on mediation. The use of pictures as stimuli should allow an increase in the size of the subject pool and thus avoid the necessity to use Ss from more than one school.

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Table 1

Mean IQs and Chronological Ages for Each Group

Prompting	IQ	Age
Order 1	58.6	14-10
Order 2	61.4	14-11
Confirmation I		
Order 1	61.0	13-5
Order 2	58.4	13-10
Confirmation II		
Order 1	61.6	15-10
Order 2	58.4	15-3

Table 2

Mean Total Correct Responses Over Eight Items in Twelve Trials

Prompting	Similar	Dissimilar
Order 1	80.125	80.250
Order 2	81.750	83.125
Confirmation I		
Order 1	75.125	90.625
Order 2	82.250	82.625
Confirmation II		
Order 1	42.250	57.250
Order 2	31.125	33.750

Table 3

Mean Total Correct for Confirmation II Order 1 Ss,

Partititoned on the Basis of School Attended

	Similar	Dissimilar	Combined
Austin State School	54.25	69.25	61.75
Denton State School	30.25	45.25	37.75